National Engineering Handbook - Amendment ME 1, EFH – 2, Updated Precipitation Data, Introduction/Background.

This amendment to EFH-2 concerns use of rainfall data developed by the Northeast Regional Climate Center (NRCC) and rainfall distributions based on the NRCC data. These rainfall data and rainfall distributions will replace rainfall data from Weather Bureau Technical Paper 40 (TP-40) and the standard NRCS rainfall distributions Type II and Type III.

This amendment will be implemented by replacing the state/county rainfall database (county.ME) and rainfall distribution types (type.rf) used with the EFH-2 computer program.

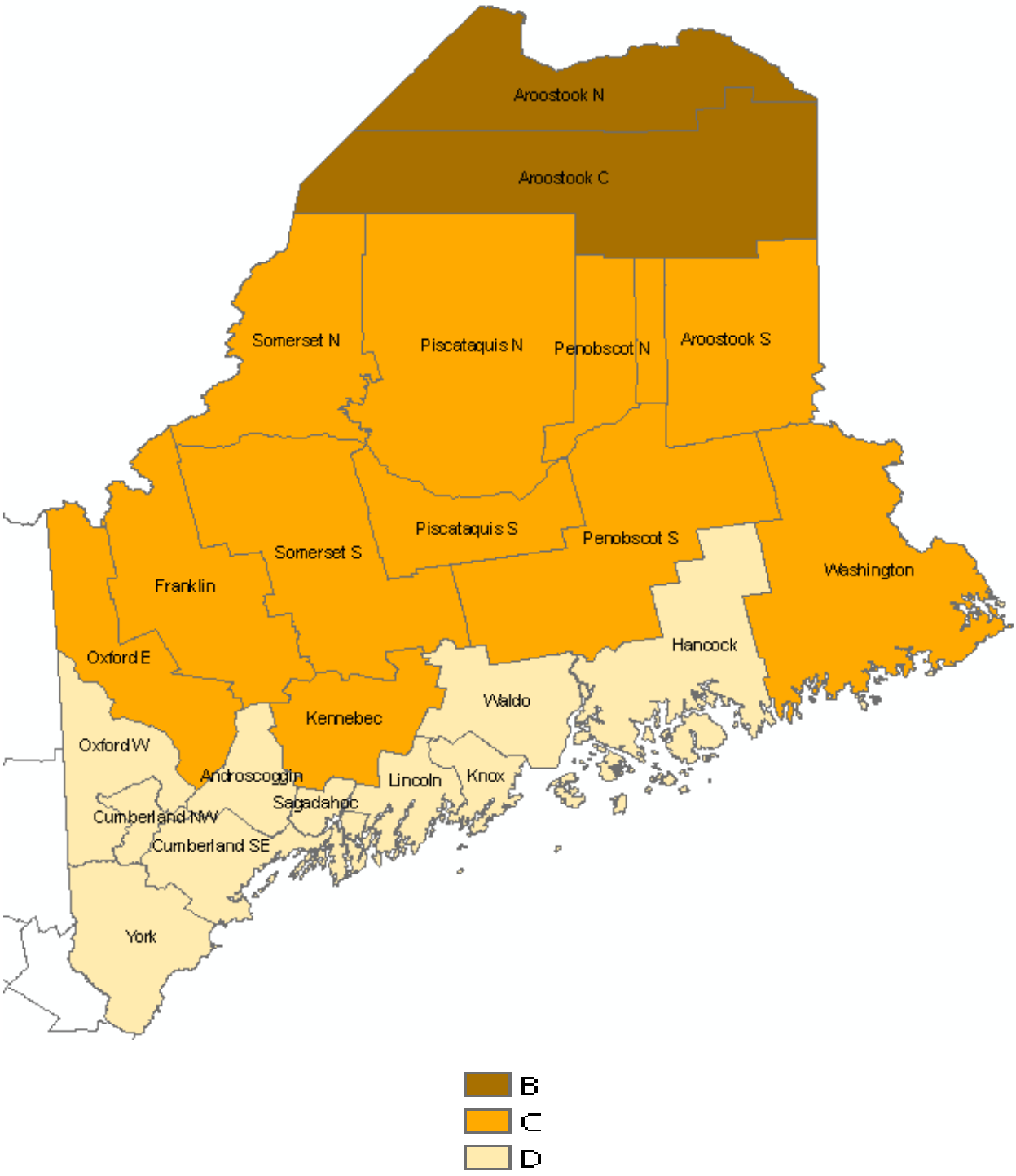
The EFH-2 computer program User Guide contains information, guidance, and examples concerning runoff curve number, average watershed slope, watershed length, input/output operations, and limitations. This supplement includes information related to rainfall data and rainfall distribution for use with the EFH-2 computer program in Maine. Additional technical information is available from the NRCC web site (www.precip.net) and NRCS technical directives such as National Engineering Handbook Part 630 – Hydrology, Chapter 4, Storm Rainfall Depth and Distribution.

Rainfall Data

The NRCC has completed a rainfall-frequency analysis for data through December 31, 2008. This is the first comprehensive rainfall-frequency analysis for the northeast states since TP-40 was completed in 1961. Data are available for specific locations from an interactive web site (www.precip.net). Alternatively, data for representative locations in Maine counties are included in a rainfall database county.ME for use with the EFH-2 computer program. The data contained in the database are included in Appendix 1 of this Supplement.

Rainfall Distributions

Four rainfall distributions have been developed for the northeast states (CT, MA, ME, NH, NY, RI, and VT). These were developed based on the NRCC data. Three of these extend into Maine. The map of the state of Maine showing where to use each of the three distributions follows.

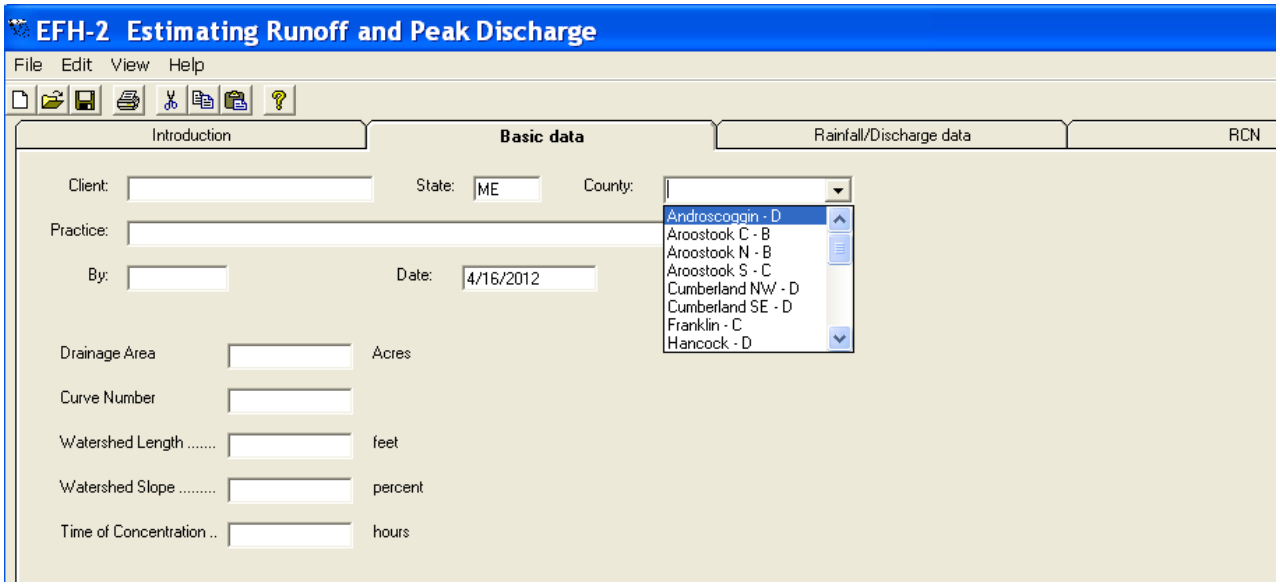


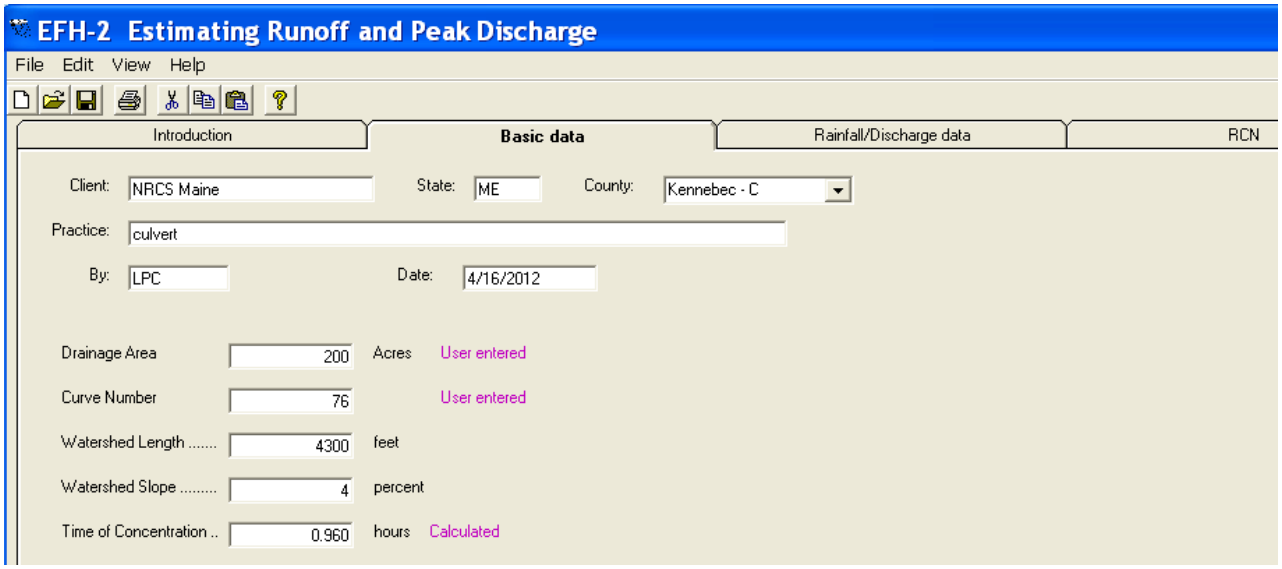
The EFH-2 computer program uses equations to relate unit peak discharge (cubic feet per second per inch of runoff per square mile of drainage area) to time of concentration in hours. The equations and coefficients for the three northeast rainfall distributions, Type II, and Type III are included in Appendix 2. Plots of the rainfall distributions are included in Appendix 3.

Example Application of the EFH-2 Computer Program in Maine

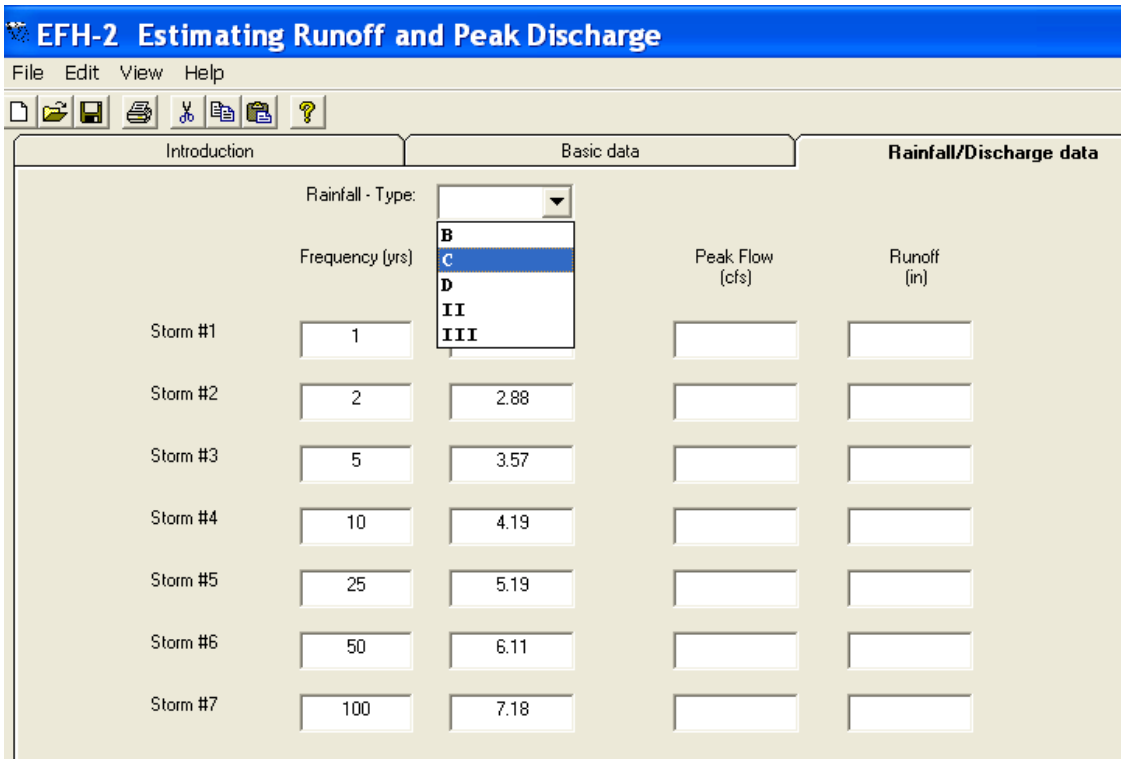
For this example, we select a small watershed in northeastern Kennebec County. The drainage area is 200 acres, the curve number is 76, length is 4300 feet, and watershed slope is 4 percent. From the rainfall distribution map above, the rainfall distribution region is "C".

Open the EFH-2 computer program and open the Basic Data tab. Enter State: ME and use the pull-down menu to select Kennebec County.

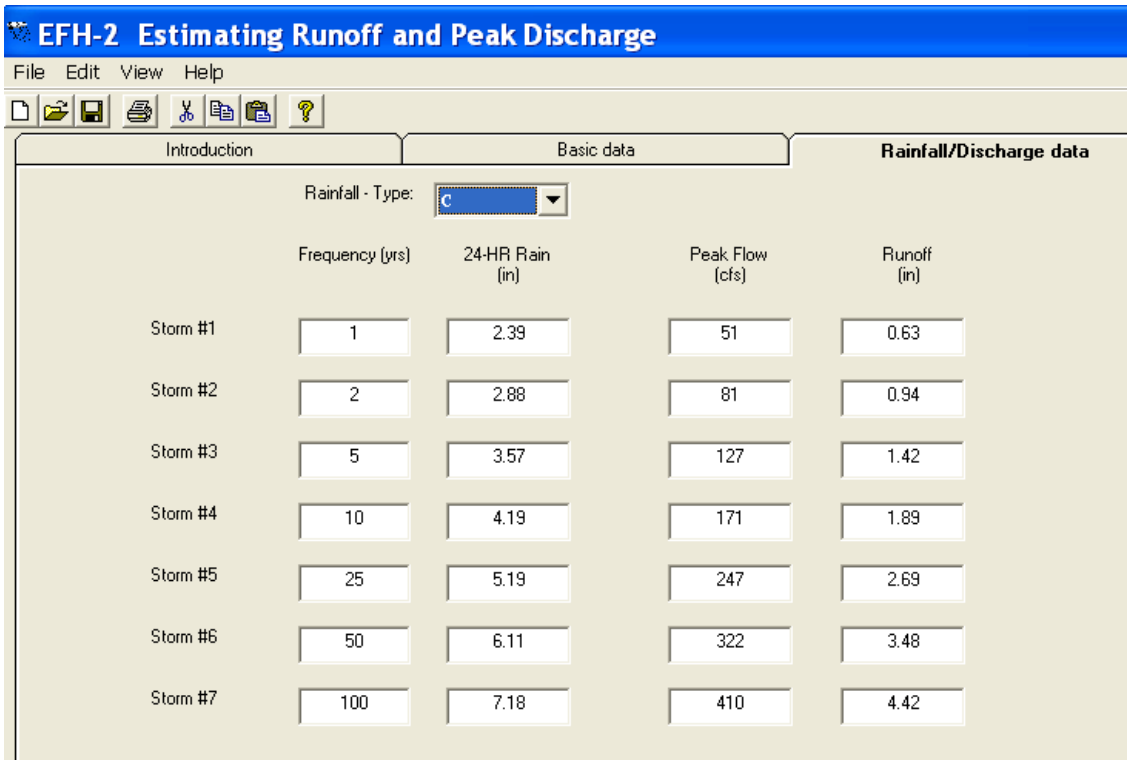




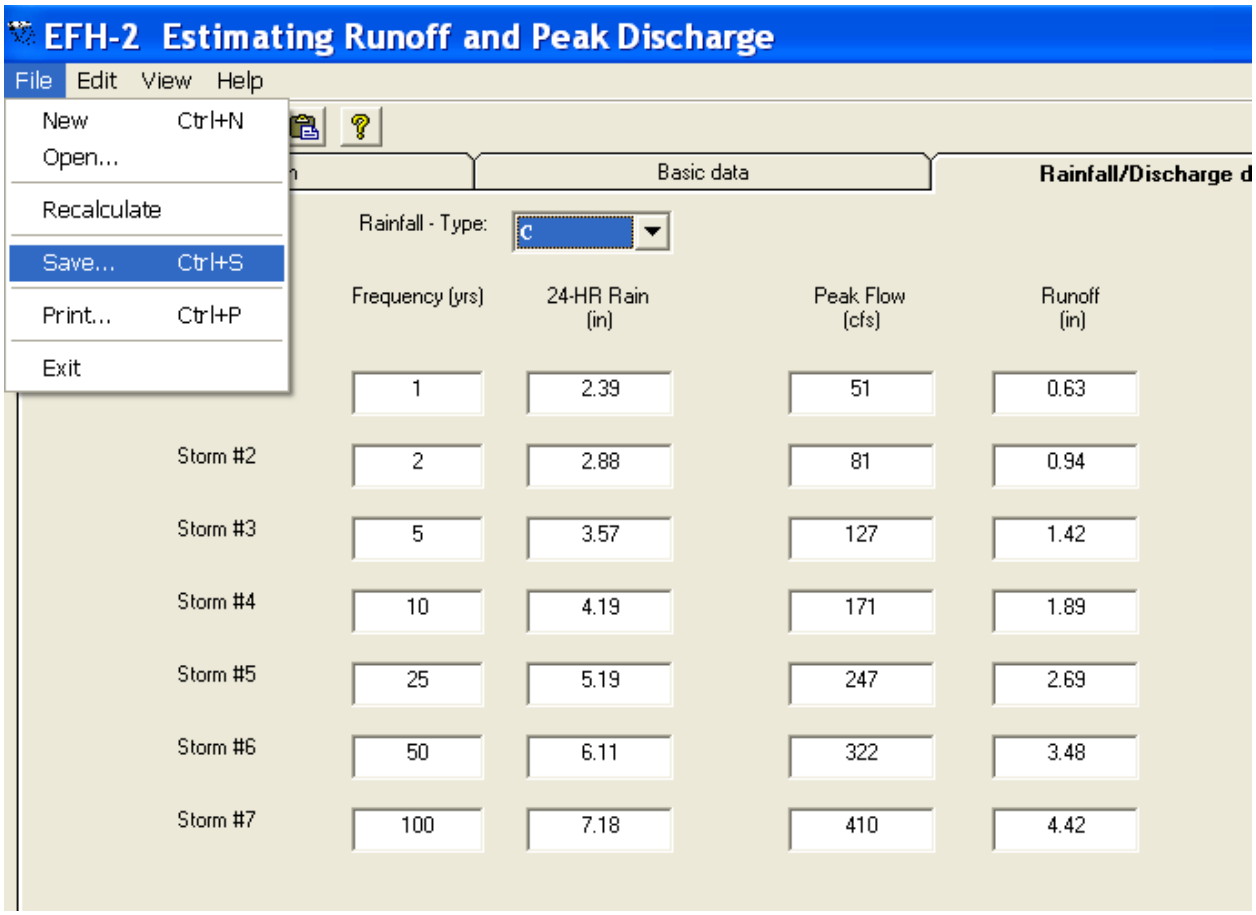
Enter the remaining data on this window. The Drainage Area and Runoff Curve Number could alternatively have been entered by opening the RCN tab. Open the Rainfall/Discharge data tab.



The rainfall data for Kennebec County has automatically been entered. Use the pull-down menu to select the B rainfall distribution.



The peak discharges and runoff volumes have been calculated.

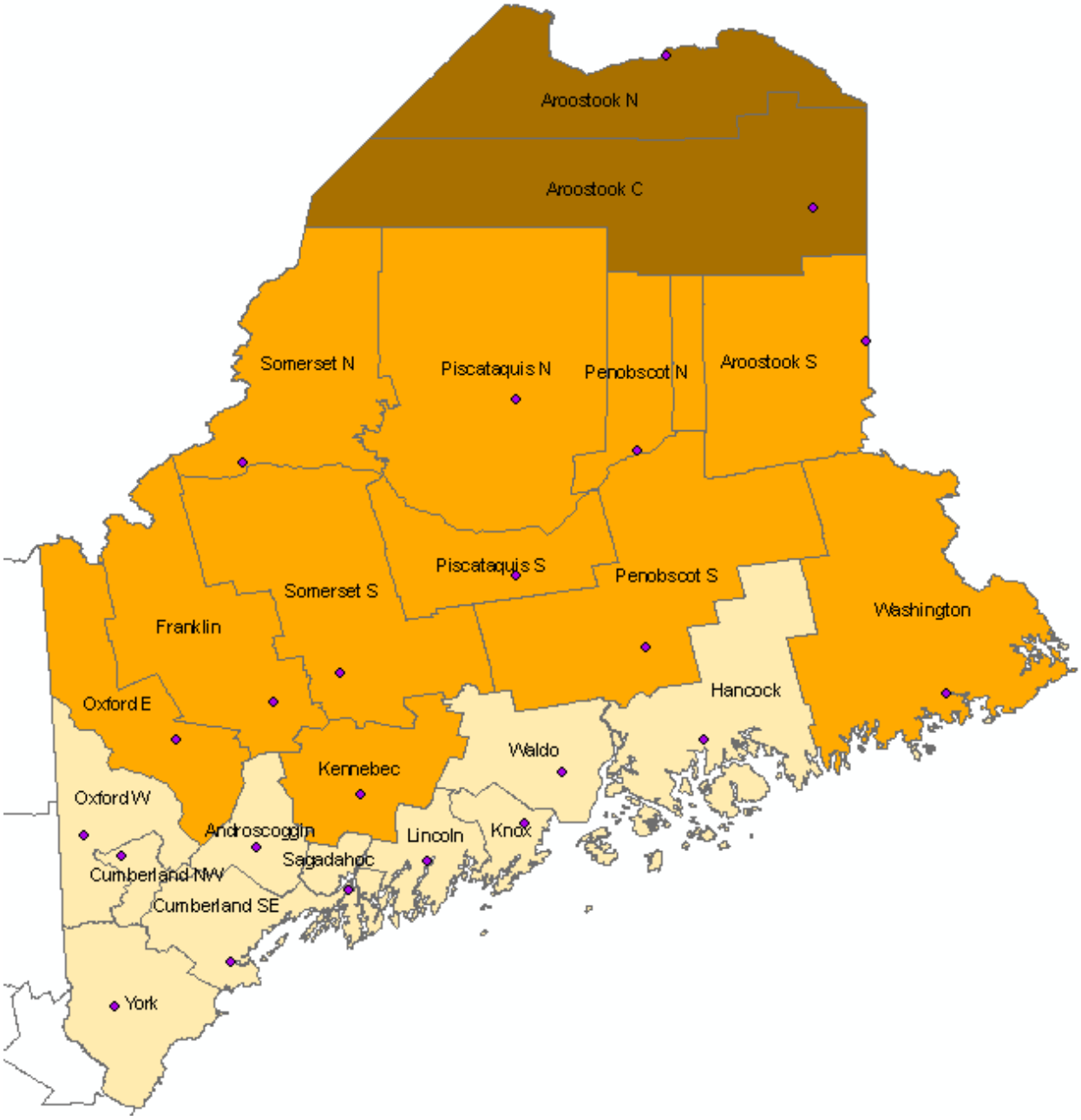


To complete the project, click File Save and File Print.

Appendix 1. County rainfall database (county.ME)

County Name	24-hour Rainfall Inches						
	1-year	2-year	5-year	10-year	25-year	50-year	100-year
Androscoggin - D	2.49	3.00	3.75	4.43	5.55	6.57	7.78
Aroostook C – B (Central Aroostook SWCD))	1.94	2.26	2.76	3.22	3.93	4.57	5.32
Aroostook N – B (St. John Valley SWCD)	1.91	2.22	2.68	3.10	3.74	4.32	5.00
Aroostook S (Southern Aroostook SWCD)	2.11	2.46	2.95	3.39	4.07	4.68	5.38
Cumberland NW – D (NW of State Route 11)	2.51	2.96	3.66	4.30	5.33	6.27	7.39
Cumberland SE – D (SE of State Route 11)	2.62	3.19	4.01	4.77	6.01	7.16	8.54
Franklin - C	2.33	2.74	3.36	3.92	4.80	5.61	6.56
Hancock - D	2.49	2.88	3.57	4.20	5.20	6.12	7.21
Kennebec - C	2.39	2.88	3.57	4.19	5.19	6.11	7.18
Knox - D	2.66	3.21	3.96	4.64	5.71	6.70	7.85
Lincoln - D	2.56	3.11	3.84	4.50	5.56	6.93	7.66
Oxford E – C (E of State Route 26)	2.29	2.72	3.37	3.95	4.89	5.75	6.76
Oxford W –D (W of State Route 26)	2.46	2.90	3.60	4.23	5.26	6.19	7.30
Penobscot N – C (N of MMA RR)	2.19	2.61	3.23	3.79	4.69	5.51	6.48
Penobscot S – C (S of MMA RR)	2.29	2.76	3.42	4.02	4.97	5.85	6.88
Piscataquis N – C (N of MMA RR)	2.08	2.49	3.08	3.62	4.47	5.26	6.18
Piscataquis S – C (S of MMA RR)	2.26	2.70	3.31	3.87	4.74	5.53	6.46
Sagadahoc – D	2.54	3.09	3.83	4.50	5.57	6.55	7.71
Somerset N – C (N of MMA RR)	1.92	2.22	2.73	3.20	3.93	4.60	5.39
Somerset S – D (S of MMA RR)	2.31	2.72	3.36	3.93	4.85	5.68	6.66
Waldo – D	2.51	3.03	3.74	4.39	5.43	6.37	7.48
Washington - C	2.62	2.94	3.58	4.15	5.05	5.86	6.80
York - D	2.60	3.21	4.04	4.80	6.05	7.20	8.57

Note: Rainfall distribution for each county is shown with the county name (Region B, C, or D).



Representative points for each county included in rainfall database

Name	Longitude	Latitude
Androscoggin	-70.217	44.100
Aroostook C	-68.000	46.650
Aroostook N	-68.583	47.250
Aroostook S	-67.783	46.117
Cumberland NW	-70.750	44.067
Cumberland SE	-70.317	43.650
Franklin	-70.150	44.683
Hancock	-68.433	44.533
Kennebec	-69.800	44.317
Knox	-69.150	44.200
Lincoln	-69.533	44.050
Oxford E	-70.533	44.533
Oxford W	-70.900	44.150
Penobscot N	-68.700	45.683
Penobscot S	-68.667	44.900
Piscataquis N	-69.183	45.883
Piscataquis S	-69.183	45.183
Sagadahoc	-69.850	43.933
Somerset N	-70.267	45.633
Somerset S	-69.883	44.800
Waldo	-69.000	44.400
Washington	-67.467	44.717
York	-70.783	43.467

Latitude and Longitude for representative points for each county included in rainfall database

Appendix 2. Rainfall distribution database (type.rf)

Peak discharge results of EFH-2 are derived from results of WinTR-20 runs. To simplify the estimation of peak discharge, WinTR-20 was run for times of concentration of 0.1 to 10.0 hours and Ia/P ratios of 0.1, 0.2, 0.3, 0.4 and 0.5. Ia is initial abstraction in units of inches. Initial abstraction includes all losses before runoff begins (interception, depression storage, early storm infiltration, etc). P is the storm rainfall with units of inches.

$$Ia = 0.2 * ((1000 / CN) - 10) \quad \text{Eq. 1}$$

where CN = NRCS runoff curve number.

Equations to relate time of concentration to unit peak discharge were then developed. The equation used to compute the unit peak discharge (q) for the EFH-2 computer program is:

$$q = 10 ^ (Coeff\_1 + Coeff\_2 * LOG(Tc) + Coeff\_3 * (LOG(Tc))^2) \quad \text{Eq. 2}$$

The coefficients to be used with each rainfall distribution are tabulated below. For example, the equation applicable to the Region B rainfall distribution region of Maine and Ia/P ratio of 0.1 is:

$$q = 10 ^ (2.4577 - 0.5833 * LOG(Tc) - 0.1091 * (LOG(Tc))^2) \quad \text{Eq. 3}$$

For a time of concentration of 0.5 hours and Ia/P ratio of 0.1, the unit peak discharge is q = 420.15 cfs / inch / sq mile.

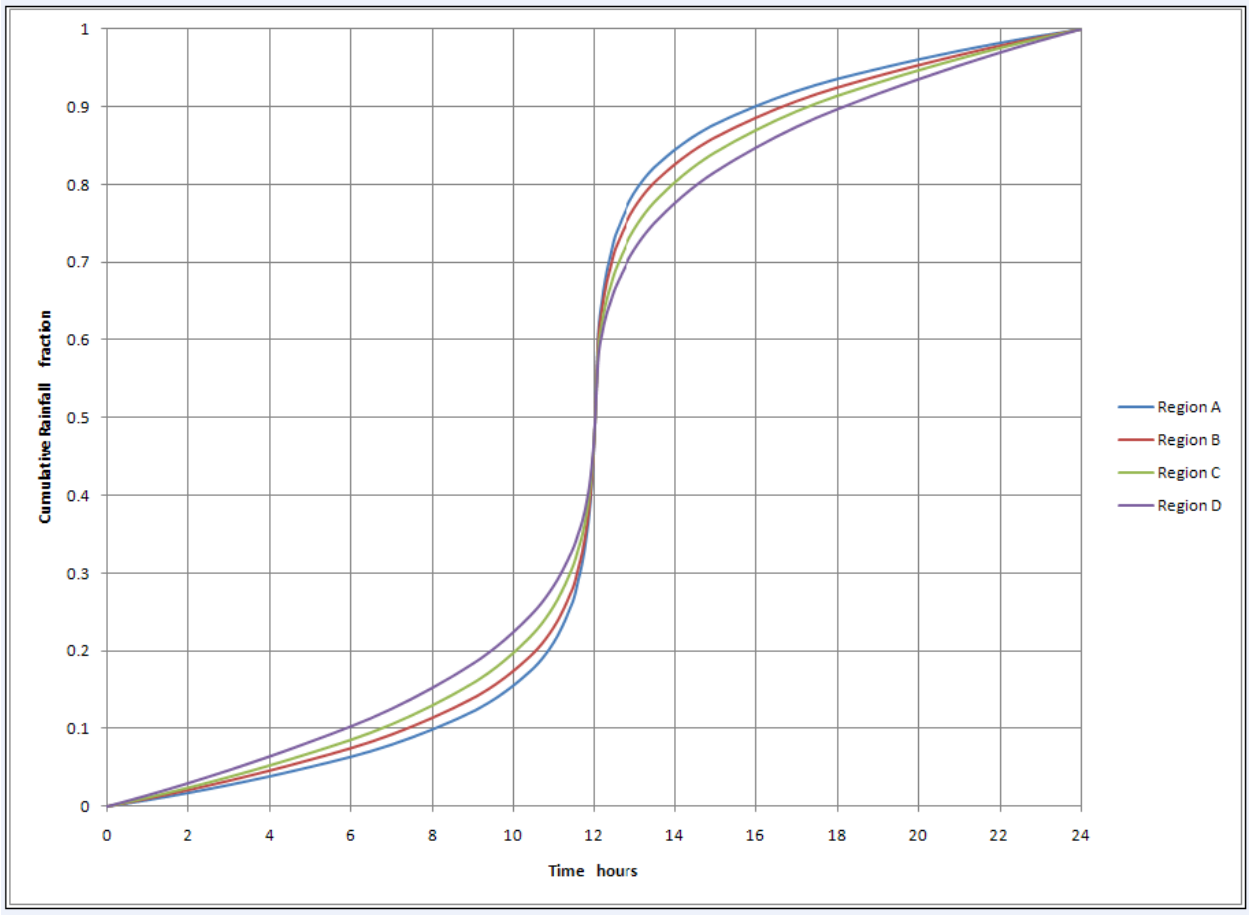
If the drainage area is 200 acres (0.31 square miles) and there is 1.5 inches of runoff, the peak discharge, Q, is:

$$Q = 420.15 * 0.31 * 1.5 = 195 \text{ cfs} \quad \text{Eq. 4}$$

Ia/P	Coeff_1	Coeff_2	Coeff_3
B,5			
0.1,	2.515,	-0.6034,	-0.1344
0.2,	2.4934,	-0.6134,	-0.1226
0.3,	2.441,	-0.6056,	-0.0986
0.4,	2.354,	-0.56,	-0.0725
0.5,	2.2249,	-0.4247,	-0.0996
C,5			
0.1,	2.4626,	-0.5834,	-0.1182
0.2,	2.441,	-0.5918,	-0.107
0.3,	2.3847,	-0.5827,	-0.0797
0.4,	2.2861,	-0.5322,	-0.0459
0.5,	2.1322,	-0.3695,	-0.07
D,5			
0.1,	2.4114,	-0.5687,	-0.1068
0.2,	2.3894,	-0.5765,	-0.0953
0.3,	2.3298,	-0.5683,	-0.0668
0.4,	2.2183,	-0.5161,	-0.0223
0.5,	2.0357,	-0.3283,	-0.0388
II,6			
0.1,	2.55323,	-0.61512,	-0.16403
0.3,	2.46532,	-0.62257,	-0.11657
0.35,	2.41896,	-0.61594,	-0.0882
0.4,	2.36409,	-0.59857,	-0.05621
0.45,	2.29238,	-0.57005,	-0.02281
0.5,	2.20282,	-0.51599,	0.01259
III,6			
0.1,	2.47317,	-0.51848,	-0.17083
0.3,	2.39628,	-0.51202,	-0.13245
0.35,	2.35477,	-0.49735,	-0.11985
0.4,	2.30726,	-0.46541,	-0.11094
0.45,	2.24876,	-0.41314,	-0.11508
0.5,	2.17772,	-0.36803,	-0.09525

Appendix 3. Plots of the northeast rainfall distributions.

The following plots are for use with 24-hour design storms. They represent the accumulated rainfall during the 24-hour storm duration on a non-dimensional basis. The maximum accumulated rainfall in the plot is 1.0 which represents the total storm 24-hour rainfall.



These rainfall distributions are represented in WinTR-20 in tabular format at a time interval of 0.1 hour.